

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2016/2017

EEM 1026 – ENGINEERING MATHEMATICS II
(All Groups)

1 JUNE 2017
9.00 a.m – 11.00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question Paper consists of 4 pages including the cover page.
2. Attempt **ALL FOUR** questions. Each question carries 25 marks and the distribution of the marks for each question is given.
3. Write all your answers in the Answer Booklet provided.

Question 1

- (a) Solve the following ordinary differential equation about $x_0 = 0$ using the power series method :

$$\frac{d^2y}{dx^2} + (1 + x^2)y = 0$$

[15 Marks]

- (b) Given the ordinary differential equation :

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} - 2y = 2e^x + 3x$$

- i. Categorize the type of the above equation. [1 Mark]
- ii. Find the complementary solution y_c [4 Marks]
- iii. Find the particular solution y_p [4 Marks]
- iv. Write down the general solution y [1 Marks]

Question 2

- (a) Using the Laplace transform, solve the following differential equation

$$\frac{d^2y}{dt^2} - 7\frac{dy}{dt} + 12y = 0$$

given the initial conditions $y(0) = 0$ and $y'(0) = 1$ [12 Marks]

- (b) The Fourier sine transform of a function $f(x)$ is defined as

$$F_s(f)(\omega) = \sqrt{\frac{2}{\pi}} \int_0^\infty f(x) \sin(\omega x) dx$$

Find the Fourier sine transform of

$$f(x) = 2e^{-6x}$$

[13 Marks]

Continued . . .

Question 3

- (a) A wave equation is given by the following :

$$\frac{\partial^2 u}{\partial t^2} = 9 \frac{\partial^2 u}{\partial x^2} \text{ for } -\infty < x < \infty, t > 0,$$
$$u(x, 0) = e^{-3x}, u_t(x, 0) = \sin(2x) \text{ for } -\infty < x < \infty$$

Solve the wave equation given above by using the d'Alembert's solution:

$$u(x, t) = \frac{1}{2} [f(x + ct) + f(x - ct)] + \frac{1}{2c} \int_{x-ct}^{x+ct} g(\xi) d\xi \quad [10 \text{ Marks}]$$

- (b) Using the method of separation of variables, solve the following partial differential equation :

$$\frac{1}{v} \frac{\partial u}{\partial t} = \frac{\partial u}{\partial x},$$

$$\text{given } u(x, 0) = e^x$$

[15 Marks]

Question 4

- (a) Tests were conducted on students from two different classes for their intelligence quotients(IQs). The IQs of 16 students from one class showed a mean of 107 and a standard deviation of 10, while the IQs of 14 students from another class showed a mean of 112 and a standard deviation of 8. Is there a significant difference between the IQs of the two groups at significance levels of (a) 0.01 and (b) 0.05?

[17 Marks]

- (b) A finite sequence $x[n]$ is defined as :

$$x[n] = \{5, 3, -2, 0, 4, -3\}$$

Find the z-transform, $X(z)$ of the above sequence and state its region of convergence.

[8 Marks]

Continued . . .

Table of Laplace Transforms

$f(t)$	$F(s)$	$f(t)$	$F(s)$
$a_1 f_1(t) + a_2 f_2(t)$	$a_1 F_1(s) + a_2 F_2(s)$	$\delta(t)$	1
$f(at)$	$\frac{1}{a} F\left(\frac{s}{a}\right)$	$u(t)$	$\frac{1}{s}$
$f(t-a)u(t-a)$	$e^{-as} F(s)$	e^{-at}	$\frac{1}{s+a}$
$e^{-at} f(t)$	$F(s+a)$	t	$\frac{1}{s^2}$
$\frac{df}{dt}$	$sF(s) - f(0^-)$	t^n	$\frac{n!}{s^{n+1}}$
$\frac{d^2 f}{dt^2}$	$s^2 F(s) - sf(0^-) - f'(0^-)$	te^{-at}	$\frac{1}{(s+a)^2}$
$\frac{d^3 f}{dt^3}$	$s^3 F(s) - s^2 f(0^-) - sf'(0^-) - f''(0^-)$	$t^n e^{-at}$	$\frac{n!}{(s+a)^{n+1}}$
$\frac{d^n f}{dt^n}$	$s^n F(s) - s^{n-1} f(0^-) - s^{n-2} f'(0^-) - \dots - f^{(n-1)}(0^-)$	$\sin \omega t$	$\frac{\omega}{s^2 + \omega^2}$
$\int_0^t f(x) dx$	$\frac{1}{s} F(s)$	$\cos \omega t$	$\frac{s}{s^2 + \omega^2}$
$tf(t)$	$-\frac{d}{ds} F(s)$	$\sin(\omega t + \theta)$	$\frac{s \sin \theta + \omega \cos \theta}{s^2 + \omega^2}$
$\frac{f(t)}{t}$	$\int_s^\infty F(s) ds$	$\cos(\omega t + \theta)$	$\frac{s \cos \theta - \omega \sin \theta}{s^2 + \omega^2}$
$f(t) = f(t + nT)$	$\frac{F_1(s)}{1 - e^{-sT}}$	$e^{-at} \sin \omega t$	$\frac{\omega}{(s+a)^2 + \omega^2}$
$f(0)$	$\lim_{s \rightarrow \infty} sF(s)$	$e^{-at} \cos \omega t$	$\frac{s+a}{(s+a)^2 + \omega^2}$
$f(\infty)$	$\lim_{s \rightarrow 0} sF(s)$		
$f_1(t) * f_2(t)$	$F_1(s) F_2(s)$		

*Defined for $t \geq 0$; $f(t) = 0$, for $t < 0$.

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